Architecture and a prototype of a collaborative system for intelligence sharing from mixed multimedia sources based on annotation

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ABSTRACT
Collection of information from divergent sources can be enriching given the fact of developments in multimedia information sources and available internet technology. The difficult question to address is how information from divergent multimedia sources can be presented for a decision support system bearing in mind human factors that are frequently raised in such kind of system. In this work, we present an architecture of how such problem is being solved particular in a decision support environment. We demonstrate three-tier architecture of a prototype of a system based on this conception.

Categories and Subject Descriptors
H.3.1 [Content Analysis and Indexing], *Indexing methods*

General Terms
Management, Documentation, Performance

Keywords
Information system, multimedia document, information research, decision making, annotation.

1. INTRODUCTION
Our conception is rooted in the fact that a document is "a trace of human activities" [11]. These traces of human activities can be transmitted using different forms of media, methods of transmission and diversity of presentation. Based on these, we qualify divergent information sources as heterogeneous documents of multimedia documents. Multimedia can be defined as "*the combination of various presentation media such as text, sound, graphics, animation, and video*". Multimedia information spans across cultural boundaries, domain of activities and formats of presentation [12]. In as well as we are not interested in examining forms of multimedia information, we are content to say that, they can be very interesting as source of information. We identify multimedia documents as document containing more than one type of support for document. In attempting to aggregate information from multimedia sources, it was noted that a mirage of grouping and classifications exist based on content or on the structure of the document. It is not our intention to approve or disapprove these classifications and assertions. We are not going to give a formal representation of these media in this work because this work is dedicated to the functional relationship in multimedia information sources, technology and the process of decision making.

Table 1: Classes of Multimedia documents

	Text	Sound	Image	Example
1				Not applicable
2			X	Paints
3		X		Music
4		X	X	Video
5	X			Book
6	X		X	Commented image
7	X	X		Advertisement
8	X	X	X	Commented Video

2. BASIS FOR INFORMATION INTELLIGENCE COLLABORATION
Our architecture is based on some of the findings in annotation for information research and four cognitive learning level implied in information research. Of course there are other cognitive levels earlier proposed by blooms [1]. The six levels may not be completely adaptable to information research for intelligence collaboration. Its complete application is evident in educational and psychological studies. The cognitive levels presented in [7] were given an acronym EQuA²te. Its relationship to information collaboration applied to multimedia documents will be discussed.

EQuA²te architecture is based on the functional characteristics that enable actors of collaborative intelligence processes make progress in the cognitive phases encountered in problem resolution [6]. Collaborative intelligence actors are decision makers, watcher and other personnel in an organization.

The acronym EQuA²te from the work [6] implied four phases of: Explore, Query, Analyze and Annotate in information management.

- **Exploration phase:** In the exploration phase, the user needs to discover the available information sources and their relevance to the problem to solve. It also provides the means for the actor to discover the types of information available. This cognitive phase should not involve the employment of the domain knowledge contrary to the general approach in IRS that is content-based. For example, most of the available IRS is based on request formulation

using the known terms on the required information.

- **Query phase:** The query phase allows the user to formulate a request by using his already acquired knowledge on his information need. The functionalities in this phase correspond to what are generally implemented in the available IRS. The principle of query formulation is based on the use of Boolean expressions of the form

  C1 Boolean-*operator C2 Boolean-operator* …,

  where

  Ci = (attribute, comparison-operator, value).

  For example, *(Author = David) AND (Year = 2001)* is expected to provide the references of documents written by David and published in 2001. This phase requires not only the knowledge on the domain but also on the techniques for formulating Boolean expressions. For example, translating "written by" to "author" is a trivial example. But how do we express the following information need using Boolean expression: "I am looking for good and recent references on user modelling". Who can evaluate as good "good" a publication?

- **Analysis phase**: In order to alleviate the problems encountered in Boolean expression formulations, the EQuA^{2}te architecture proposed the possibility for the user to express his information need by cross analysis, using the various attributes of the objects managed in the information base. For example, the user can request the cross analysis of the authors and the keywords like in *(attribute1 = author, attribute2 = year).* This provided the distribution of the keywords over the authors.

- **Annotation phase**: The annotation phase allows the user to evaluate the relevance of the solutions proposed by the system. It also allows the user to explicitly represent the knowledge that he may

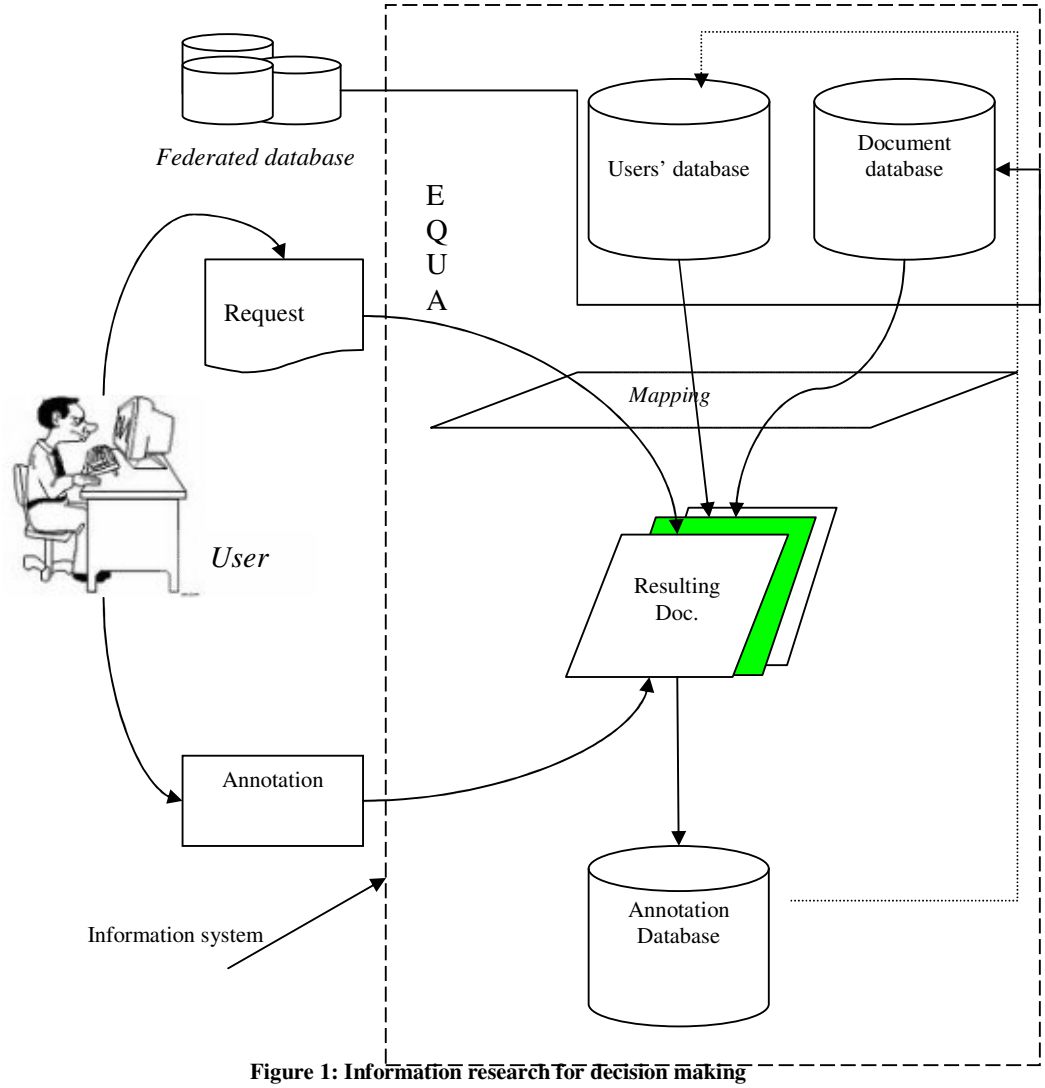


Figure 1: Information research for decision making

have discovered.

This annotation phase is particularly useful for associating the solutions that were evaluated to be relevant to the problem to be solved. When a solution is explicitly associated to a problem as been relevant, this will provide a means of using a case based reasoning technique for solving relevant problems.

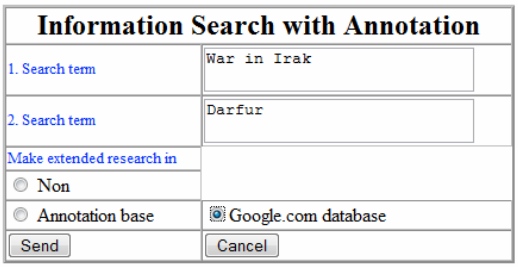
3. ARCHITECTURE OF A COLLABORATIVE SYSTEM

From Figure 1, a user sends a request to the information system (marked with dashed line). In the current application, the system makes use of a data base of bibliographical documents of the SITE research. The request of a user is mapped with the document base located on http:\\metiore.loria.fr.

Compared to work of SITE research team, the first three functionalities were implemented in an information research system developed in the team called METIORE [4].

METIORE system allows users to be able evolve in the different evocative levels during information research (observation, elementary abstraction, symbolization and reasoning, and creativity) [5]. It is a system of information research applied to bibliographic references. The system is contained a collection 5000 bibliographic references of LORIA laboratory. We believe that bibliographic databases are just an example of multimedia document. Conceptions and propositions on bibliographic databases can be extended to every other type of multimedia documents.

Figure 2 : Interface for extended information search



This work is not intended to give a specific representation of multimedia documents from the perspective of their format. It was thought that, it is near impossible to represent all the possible format of multimedia information sources. If it is impossible to completely represent multimedia documents, it may be tempting to say that it will be impossible to provide a method for information research from sources that are near impossible to represent. The effort in this work will be described and proposition for associated collaboration and information search from heterogeneous multimedia sources with the Figure 1.

The system consists of three databases where information search can take place: document database, annotation information source and federated database. The federated databases consist of all imaginable databases (information source) of heterogeneous document formats. Each of the databases has its own independent specificity. They are mutually independent. Database that may consist of text, some other are a mixture of text and sound. A profound consideration that permits the access through the use of "interface" between federated databases and document database is required. In short, detail information in federated database is not of great importance in this work because of its complexity.

In the scope of this work, information is searched from document database, federated database and annotation database. Essentially, the federated database and annotation databases are complementary to the target information source.

The request sent by a user corresponds to the expression of the informational collaboration. In the prototype, three types of request are possible. The three are explore, query and analyze. Information mapping is done by the system to find information from the document database which corresponds to the best expression of the user's request.

User's can annotate the resulting documents which are stored in an annotation database. The annotation database is fed back to the document database to help improve the source database.

4. A PROTOTYPE OF THE SYSTEM

In this section, we will describe a prototype we realised on a web server in our laboratory based on the conception in this study. We chose to implement a prototype of this system with internet technology by employing 3-tiers architecture. We present the architecture briefly as follows:

The three-tier architecture is composed of three elements that can be seen precisely as three layers. The three layers are the presentation layer, the data layer and the application layer.

The presentation layer is related to the display of information associated to the client in our system. This layer permits user to send a request to resource situated on a distant web server www.loria.fr. In our case, this layer is presented as a form of web browser. The client machine on this layer is linked to the web server by TCP/IP network. User's request is assured on the internet connection by the http protocol.

The application layer is a functional layer that assures the processing of sent request and corresponding response. Several applications are of importance in this case. For this prototype, we use the PHP server integrated to the web server http://www.loria.fr at the back end. We are considering other kinds of application such that will be able to run ASP scripts and VBA. We are of the opinion that these are important because, some of the functions in a multimedia database are not easily realisable on a PHP environment.

The data layer is linked to the database server. The essence of the database is to store and manage the associated information. Commands sent by the query of users are managed the integration of PHP/SQL commands in related programs. Our data layer is hosted by the mysql.loria.fr server.

In our conception, it is possible to make information research from our database coupled to an annotation base. We are not particularly concerned with the creation and

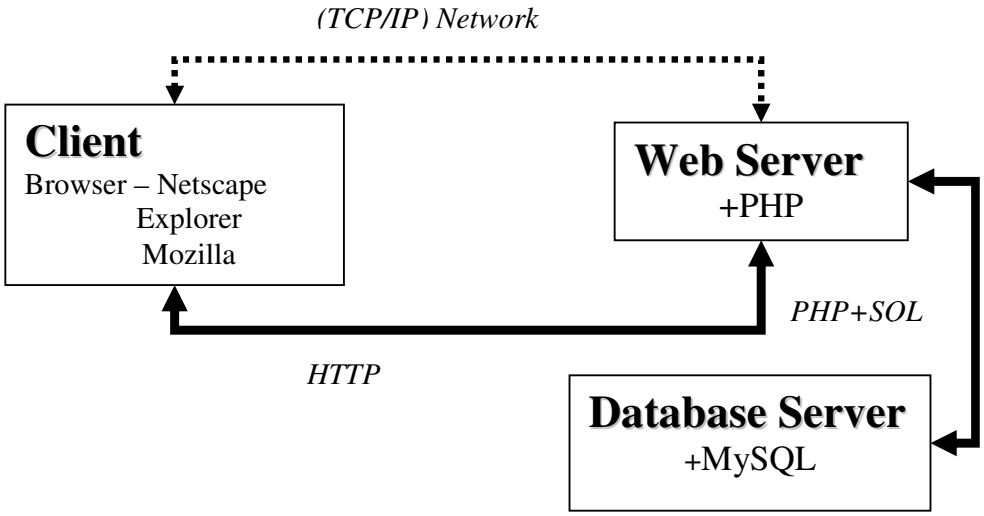


Figure 3: Three-tier architecture for information research

management of annotation in this study. Creation of annotation may take different consideration. Annotation creation was presented in [9] based on the user, the document and time.

Information creation based on multimedia documents will consider connection between document database and federated database which can be achieved by sending search terms to popular search engines (example google or metacrawler). With google API which is freely available, we can automatically extract parameters of multimedia documents on the net into our system.

The current version we have available on the internet was built on the fact that a text document is a class of multimedia document. A section that is operative now is querying the annotation made on text documents can be for example, "objective of annotation", "type of annotation", etc. It must be noted that an annotation can be seen as document on it own. All the query parameters applicable to annotation can be adapted to all type of multimedia documents. To query multimedia documents, we will need to sufficiently define each class of the multimedia document as to permit its query.

5. INFORMATION RESEARCH, ANNOTATION AND DECISION SUPPORT

When information is sought, it is generally done to reduce uncertainty. The reduction of uncertainty is the bases for decision making. Decision making is a cognitive process of choosing among alternatives based on explicit or tactic assumptions. A rational decision will be based on verifiable information.

We prefer to use the word "intelligence economic" as compared to the other substitutes like competitive intelligence and business intelligence. The latter terminologies are preferred in the united state and Britain respectively. It may be difficult to prove the differences. The word economic intelligence is taking strategic decision based on information collected rationally and legally. The clear difference between spying, competitive intelligence or business intelligence and economic intelligence is that, in economic intelligence; we believe that to take strategic decisions, we do not have to be in competition, or use the information for business or military purposes. Taken action on information may not necessarily imply competition. Taking decision is life-long process that span through business, family, academic or other less important human endeavours.

The process of annotation ends with the annotator but the document he annotates is tied to the source document that originates from an author who published his ideas based on a particular concept from the information world. The author of a document begins by studying the information world around him. This world contains different kinds of information. He identifies one or more type of information that is of interest to him. The idea he had from the subset of the information world is used to compile a document.

Every reader of a document is a potential annotator. He only needs to be inspired or attracted by one or more issues in the document he read. The inspiration he had from the document forms the basis of his annotation. When an annotation is completed, it can form the basis for another annotation in the future or is read in the company of the source document.

When an annotation is presented, we may be bothered with questions like: Why was the annotation made? Who is the personality that made the annotation? When was the annotation made? The answer is not often stated in the annotation. How do we resolve this kind of situation? If we can successively answer these questions, analysis can be made across annotators, with time and across documents.

Analysis of annotation with these parameters will not only prepare annotation as a source of additional

information source but as a means of resolving some decisional problems [10].

6. CONCLUSION AND PERPECTIVES

We have been able to demonstrate how we implemented an information system considering the complexity of multimedia document and human aspect for decision support. Information can be searched from heterogeneous sources by providing a linked document database. The link is to heterogeneous document sources to provide for additional detail when necessary. We provided an architecture for information researched based on four cognitive level of explore, query, analyse and annotate. A bibliographic document database was used as a point of reference. We believe that with the use of bibliographic document, we can extend search to other forms of multimedia document.

With several API available on the internet, we hope to incorporate the possibility of incorporating detail information from federated sources..

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